Resource Management

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Caption: *Mountain lion female (F250) gets "caught" on camera entering Wind Cave*

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THE END OF THE WORLD IS NEAR!

Arsenic in the Groundwater and Nuclear Fallout in the Rain!

By Marc Ohms, Physical Science Tech.

In 2012, two reports from the US Geological Service (USGS) have been published that involve Wind Cave National Park. To the uniformed (or misinformed) the results of these studies may sound apocalyptically alarming (it is 2012 after all). Before you start popping iodine pills with bottled water, please continue reading the following information.

Figure 1. Elemental Arsenic

Arsenic

The study involving the levels of arsenic in our groundwater was the result of a four-year study conducted by Andy Long of the USGS and Marc Ohms of Wind Cave National Park. The project was funded through the USGS/NPS Water Quality Partnership Program. We sampled water from over sixty sites throughout the southern Black Hills including wells, springs, cave drip water, and cave lakes. Besides arsenic, we sampled for common ions, stable isotopes, specific conductance, pH, nitrate plus nitrite, various trace metals, tritium, chlorofluorocarbons, and dissolved gases. However, the concentration of arsenic is what hit the news when the report was published. To see the full report you can either go to the X drive on the network or on-line at http://pubs.usgs.gov/sir/2011/5235/ The purpose of the study was not solely focused on arsenic, but to use the chemistry and characteristics of the water to determine flow paths of the groundwater.

Arsenic occurs naturally in rocks and soil, water, air, and plants and animals. It can be further released into the environment through natural activities such as volcanic action, erosion of rocks and forest fires, or through human actions. Approximately 90 percent of industrial arsenic in the U.S. is currently used as a wood preservative, but arsenic is also used in paints, dyes, metals, drugs, soaps and semi-conductors. High arsenic levels can also come from certain fertilizers and animal feeding operations. Industry practices such as copper smelting, mining and coal burning also contribute to arsenic in our environment. (US EPA 2012)

Ingesting large doses of arsenic can have adverse health effects. The US Environmental Protection Agency (EPA), who regulates public water supplies, has set a maximum contaminant level (MCL) of 10 parts per billion (ppb), which is the equivalent of a few drops of ink in an Olympic-sized swimming pool. Although short-term exposures to high doses (about a thousand times higher than the drinking water standard) cause adverse effects in people, such exposures do not occur from public water supplies in the U.S. that comply with the arsenic MCL. Some people who drink water containing arsenic in excess of EPA's standard over many years could experience skin damage or problems with their circulatory system, and may have an increased risk of getting cancer. (W*ikipedia 2012)*

Wind Cave National Park's water supply has never been out of compliance with the EPA's MCL for arsenic or any other component. Prior to 2006 the MCL for arsenic was 50 ppb, but as the knowledge grew about the accumulative effects of arsenic, the MCL was lowered to 10 ppb. Private homeowners with wells do not have to comply with the regulation, and it is estimated that over 20 percent of private wells in the US are over the 10 ppb MCL. The highest levels we found during this study were from private wells south of the park, with levels of arsenic up to 3 times the MCL.

If you think it best to buy and consume bottled water, you might want to know that bottled water companies are not considered by law to be public supply. Thus they do not have to test their water source nor comply to the same regulations and laws. Therefore the level of arsenic, or any chemical for that matter, in bottled water can be very high without any regulation, and the companies are not required to publish or even share test results. All public water supplies such as Wind Cave's are required by law to comply with the EPA's regulations, bottled water companies are not. I will let you determine which is safer to drink.

Nuclear Fallout

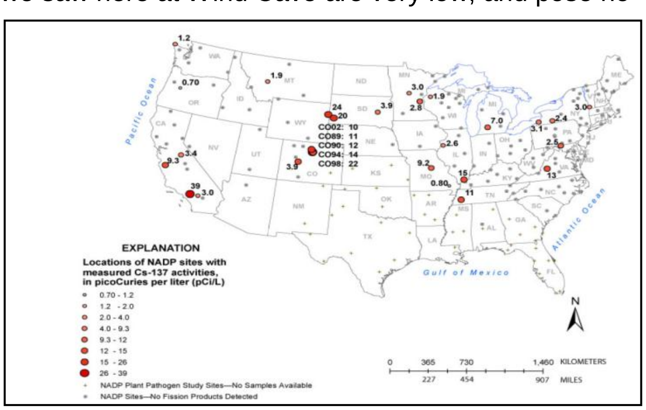
On March 11, 2011, a magnitude 9.0 earthquake centered off the Pacific Coast of Japan triggered a tsunami and a 14-meter high tidal wave that inundated the Fukushima Dai-Ichi Nuclear Power Plant near Sendai, Japan. The facility was left without electric power, which resulted in failure of the cooling systems for its six nuclear reactors. This led to the discharge of radioactive materials into the atmosphere, including fission-product isotopes iodine-131, cesium-134, and -137. These isotopes were reported in many different countries in the Northern Hemisphere at variable but low levels. (*Wetherbee, et. al. 2012*)

As of summer 2011, precipitation was being collected weekly from 251 sites within Canada and the United States, including Alaska, Puerto Rico, and the U.S. Virgin Islands. Sites with a National Atmospheric Deposition Program (NADP) collector system were used to monitor fission-product isotope fallout. Wind Cave National Park just happens to have a NADP collector!

Within 48 hours after the release of radioactive material into the atmosphere at the power plant in Japan, the NADP coordinated with the USGS to put a plan in place to measure radionuclide fallout in NADP precipitation samples. Samples were collected and analyzed for the week before contaminated air arrived over North America (March 8–15, 2011) and no fission products were detected in the pre-arrival period samples. (*Wetherbee, et. al. 2012*)

Fission products were detected in precipitation samples from 35 individual NADP sites, including Wind Cave (Figure 2). At Wind Cave, Cesium 137 and Cesium 134 were detected. The Cesium 137 has a half-life of 30 years, so this will be floating around the environment for some time. Vast amounts of cesium-137 were distributed across 40 per cent of Europe's surface after Chernobyl. Environmental levels remain elevated in wildlife, with restrictions still in place on eating some sheep farmed in the UK, and game and mushrooms from elsewhere. However, exposure to environmental cesium-137 from Chernobyl has never been linked conclusively to any direct health effects in people, although researchers are divided over whether there is no effect, or just not enough data to say (MacKenzie, 2011).

Although this should not be taken lightly, the levels that we saw here at Wind Cave are very low, and pose no



immediate danger. We are exposed everyday to levels of radiation from various sources such as natural radon, and there are still traces of radioactive particles floating around the atmosphere and in our water from the nuclear bombs, bomb testing, and other nuclear power plant accidents in the past.

It is easy to think that our lives are only affected by our immediate environment, but this is a grave reminder that events thousands of miles away have impacts on our lives and wellbeing. With over 400 nuclear power plants worldwide (104 in the US), problems are likely to occur again in the future.

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South Dakota Game, Fish and Parks and Wind Cave Cooperative Mountain Lion Study

by Duane Weber, Wildlife Technician

In late November 2011, the SD Game Fish and Parks Department approached Wind Cave requesting to capture an adult male mountain lion (that was using the park) that was due for a collar replacement. The replacement collar would have active GPS, weekly relaying locations of the lion to Game Fish and Parks Staff. As the locations collect, any gathering of three or more points, termed a "cluster", would be reported to Wind Cave for us to investigate the lion's activity in that area. These clusters often reveal a kill site. At the kill site data is collected about the activity at the site and information about any prey remains that may be found.

The park whole heartly agreed with the proposal. The male, now known as M236, was captured and recollared along Beaver Creek just onto the Casey Addition. By the first week in December 2011, we were receiving weekly GPS cluster locations for to investigate. Along with M236, we were also receiving clusters for an adult female, F250, that also hunts the park. Between the two collared lions we were getting 3 to 9 clusters within the park eack week for us to investigate, and we were collecting data on 1-3 kills each week.

Clusters are investigated after a compillation of locations from the previous week. We are esentially following a week behind the lions and their travels. This minimizes our disturbance of the lions at a kill as each kill is a hard won prize and critically important to that lion.

The adult male, M236, was a wizzard at killing elk. For the first several weeks of our following his clusters he was killing adult elk, and most often bulls, at a rate of about one per week. In most cases they were adult breeding age bulls with 5X5 and 6X6 sets of antlers! As the weeks and data gathered this male also killed cow elk, white-tailed deer and on one occasion killed and ate a coyote.

The adult male M236 was killed in March 2012 while he was out of the park and during the last few days of the mountain lion season.

The adult female, F250, continues to provide weekly clusters for us to check and she averages 1 kill a week within the park. Her range extends out the west side of the park as well, so she keeps the SD Game Fish and Parks crew checking on her clusters out of the park We have verified her killing white-tailed deer, mule deer, elk of all ages (with preference for the young and cows), and the occasional turkey.

The most interesting observations so far have included the killing of two radio collared cow elk within a ten day period, one in thepark and one out. The lion killed elk in the park was located as part of following up on the clusters. Imagine our surprise when the victim turned out to be wearing a radio collar! The adult cow had provided meals for 4-5 days before F250 gave up the carcass to the bugs.

Then a little over a week later as I was following up on a mortality signal for elk 11_F_166_592; it appeared it was a lion kill. A large pile of grass concealed the carcass of the elk with the exception of one patch of hide. As I approached the carcass,at less than 150 feet, the “patch of hide” jumped up and ran away! Lion F250 was at the kill!

Radio collared elk killed by female lion F250

Another interesting trait of F250 is her habit of leaving very little behind for us to investigate. For deer sized prey, she will consume everything but the hair, lower leg bones, and sections of jaw and skull that hold teeth. No hide, no skull, no ribs, no spine, no pelvis remains.

Next Steps in Wind Cave Canyon Rehabilitation Project

by Beth Burkhart, WICA botanist

This is a sequel to Summer 2011 Resource Ramblings article: “First Steps in Wind Cave Canyon Restoration”. The first article summarized the challenge in Wind Cave Canyon in the Headquarters area relative to researching, planning, and implementing management to support native vegetation (species and communities) in a nexus area for visitor use/protection, park maintenance, cultural resources, and natural resources.

The 2011 article ended with a heads up to watch for Wind Cave Canyon Pilot Project in the fall of 2011. That project took place as planned last October. All Rocky Mountain juniper trees were removed from a 20m by 30m (60ft x90ft) area adjacent to the northeast corner of the Visitor Center - because RM juniper density is the most out-of-line characteristic of Wind Cave Canyon vegetation relative to Great Plains/Black Hills wooded draws. Native shrubs were also reduced in number/density towards more typical levels. (See Figures 3 and 4 for before and after views of the pilot project area.)

The result was a big change for people that see the area every day but not so unusual for others. It looks freshly disturbed, though, and we are looking forward to the 2012 growing season to watch the vegetation respond and smooth over the rough edges of mechanical manipulation. We will also determine and implement appropriate invasive plant species treatment. One of several things we would like to learn from the pilot project is whether the hypothesis is true that increased direct sunlight will reduce habitat compatibility for several invasive species of concern. It appears that many invasive species found only in Wind Cave NP in Wind Cave Canyon are here because of the atypical ecological conditions.

Also since last summer, Greg Eckert (NPS Restoration Ecologist) visited Wind Cave NP (October 2011) to participate in a recon and brainstorming session on Wind Cave Canyon vegetation with local experts (WICA Resource Management, NGP I&M, and NGP Fire staff). Over the winter, WICA Botanist Beth Burkhart researched vegetation desired conditions from multiple scientific perspectives (from NRCS Ecological Site Descriptions, DOI/DOA LANDFIRE, US

National Vegetation Classification, etc.). Greg returned to the park and facilitated a park-wide meeting on March 21, 2012 where we shared research and ideas on the resource dimension of desired conditions for Wind Cave Canyon and solicited input/interaction from all park staff on human and institutional dimensions of desired conditions.

Figure 3. Pilot project location before Rocky Mountain juniper trees removed (July 2011); note tour shelter in top center.

Figure 4. Pilot project location after Rocky Mountain juniper trees removed (October 2011); note tour shelter in center.

Although the complete Wind Cave Canyon Rehabilitation Project will cover the full length of Wind Cave Canyon in the park [from the west boundary/Elk Mountain Campground to the Casey new addition fenceline (east of the park wells)], the stretch from the picnic area to just past the VIP Center will receive attention first. This area exhibits the most deviation from desired condition and funding is available for work in this segment in 2012.

Description of desired conditions for Wind Cave Canyon 2012 Project Area from the Resource dimension:

Vegetation is a mix of patches of forest, woodland, shrubland and herbaceous vegetation that changes over time and space. Vegetation types include ponderosa pine/chokecherry forest, boxelder/chokecherry forest, ponderosa pine/little bluestem woodland, ponderosa pine/western wheatgrass woodland, chokecherry shrubland, leadplant shrubland, western snowberry shrubland, and western wheatgrass/Kentucky bluegrass complex herbaceous vegetation.

Density of ponderosa pine tree cover varies from none (in herbaceous and shrubland communities) to moderate (moderate average canopy cover = 40%).

Density of hardwood tree cover (boxelder, American elm, green ash) in stands of hardwood communities varies from 10-25%. Tall and short shrub cover varies from none to dense (dense cover = 75%; species composition of shrubs includes primarily chokecherry, plum, gooseberry, skunkbush sumac, poison ivy).

Herbaceous cover varies from 1% in forest stands to 75-90% in shrublands and grasslands.

Rocky Mountain juniper is occasional and comprises 1% or less canopy cover in woodland and shrubland communities, primarily in the tall shrub layer [between 1-5 m (3 to 15 ft)].

Federal, state, and county-listed noxious are minimal (<.1% cover). Other invasive species comprise <1% of total cover.

Institutional and Human dimensions developed at the March 21 meeting will be added to the Resource dimension to result in a comprehensive desired condition. The Institutional and Human dimensions provide important safety and infrastructure aspects. Visitor experience/use is also very important, but it is fundamental that visitor experience be based on natural resources/ecosystems and dynamics understood through best available science in a long-term context. A national park is not a zoo or arboretum or garden where visitor use is a driver of natural resource form/function.

2012 Wind Cave Canyon Rehabilitation Project Implementation Plan and a WICA Environmental Screening Form are currently being developed. Additional input/ideas can be provided at any time to Beth Burkhart, WICA Botanist. The 2012 Wind Cave Canyon Implementation Plan and ESF will have a review period by the park leadership team (June timeframe) and any staff employees they include. When the project is finalized and approved by Superintendent Davila, cultural compliance will be completed. Finally, Wind Cave Canyon restoration will begin to be implemented in Fall 2012.

It is already clear that there is no way the Wind Cave Canyon Rehabilitation Project can possibly meet everyone's desired future conditions. However, we can't afford to turn away from hard decisions, to default to doing nothing, because not everyone is happy with a single course of action. The status quo is not working to meet the mandate that Wind Cave Canyon's natural and cultural resources be conserved unimpaired for future generations. It is hoped that the discussion and process we are going through to develop the desired condition and plan will allow everyone to understand, support, and explain to the public the package that becomes the final project. It's also hoped that everyone will become excited to watch Wind Cave Canyon's dynamic future unfold with thinning, fire, etc. - even if it is isn't the face of the canyon we've become accustomed to in the last 50 years of suppressed disturbances (e.g. fire).

The Wind Cave Resurvey Project

By Rod Horrocks & Marc Ohms, WICA Physical Science

Photo caption: (L-R) Rod Horrocks, Duff McCafferty, & Roger Harris resurveying the AV survey in the Historic Section of Wind Cave.

Soon after starting as a Cave Management Technician at Wind Cave National Park in 1999, Marc Ohms began to work with the Wind Cave survey data. By 2000, a year after Marc and I had taken over the cave management program at the Park, we realized that there were problems in the Wind Cave survey data. Marc found significant loop closure problems or blunders in 25% of the 900+ loops. We noticed that many of the surveyors had not recorded LRUD (left, right, up, or down) data and some had not taken inclination shots on low-angle shots. I was also finding it difficult to survey many of the side leads in Wind Cave because the early surveyors had tried to maximize the lengths of their shots. They sometimes bypassed multiple leads with a single shot. I realized that we had to either resurvey those shots in order to establish points at each junction or we had to create redundant shots from the nearest station that would then have to be excluded from the length of the cave; which technically was not a problem, but I thought it made things messy, especially with the map. When we combined these facts with the quality of many of the sketches, which were not drawn to scale, often had no interior passage detail, and only showed the major side leads, we came to the realization that we needed to resurvey a bunch of Wind Cave. We had two choices, we either had to stop the new exploration project altogether and concentrate on resurveying nearly half of the cave, or we had to do both projects simultaneously. In order to keep volunteers interested in the survey project and to continue to learn more about the resources that we were tasked with managing, we decided to do both projects at once. The Wind Cave Resurvey Project was born.

After analyzing this issue in depth, we determined that most of the surveys in question were done before survey standards were enacted by the first cave management position in 1985. Looking at just those surveys, we realized that we had 183 surveys that included 37.07 miles of survey that predated cave management in the park. We decided that we needed to prioritize what we resurveyed, starting with the most serious data problems first and then move on to sketching problems later. Marc began the process by identifying the surveys that had the most serious loop closure errors. In 2004, he put out a list of 151 surveys that we would concentrate on. Although, these included surveys from several sections of the cave, the majority were found in the Historic Section. Not surprisingly, the oldest surveys had the most problems. In fact, it seemed that the survey quality improved with each decade, with the 1950's producing the worst data, except for the 1959 NSS Expedition to Wind Cave, which produced three miles of fairly good quality data. The 1960's were only slightly better than the 1950's and the 1970's only slightly better yet.

The first significant improvements in the data were realized in 1978, when John Scheltens created survey standards for his volunteer survey group in a document he called an "Operations Manual". These standards required distance measurements to be within a tenth of a foot and compass declinations to be set at zero. He also discouraged steep shots with vertical angles over 40 degrees (Scheltens, 1978). Although, this Operations Manual was not adopted by the Park, it undoubtedly had a positive influence on later Park survey standards. By the 1980's, there began to be improvements in the quality of the sketching too. In 1991, Jim Nepstad created cave survey standards for all surveyors working in Wind Cave. In those standards, he established loop closure errors of less than 1% for loops longer than 500 feet. For loops under 500 feet in length, a <2% closure error was set. Although these standards required that surveyors that failed to meet these closures were to be banned from reading instruments in the cave, to our knowledge this never happened; possibly because it was realized that loop closure errors may not be only the fault of the instrument person. These standards also required sketchers to sketch to scale and to maintain angles of plotted shots on their sketches to within 10 degrees of their actual angles (Nepstad, 1991). These standards led to real improvements in the quality of the Wind Cave survey data.

By the end of 2000, we realized that we were still seeing new loop closure errors, even among the most experienced survey groups. We hypothesized that the culprits were the steep angle shots. So, we decided to implement a mandatory foresight and backsight for each shot with an inclination over 30 degrees. At the same time, we created a Sketchers Evaluation Form to help sketchers improve their sketch. By 2002, we were still seeing high levels of loop closure errors, so a few trip leaders started doing backsights on all of their shots. We finally decided to make it official in 2005 and require backsights on every survey shot that was not a dead-end shot (Horrocks, 2011). New loop closures errors have dropped dramatically since that policy change.


Marc Ohms and two others conducting surveys

Since he started working with the Wind Cave data, Marc has been using the COMPASS software to analyze loop closure errors. Once he identifies a problem loop, he starts by verifying the computer data against the original data to find potential data entry errors. Tie-ins with other surveys are double-checked to be sure that the tie-in was actually to the station recorded. This has been found to be a significant source for errors. Then magnetic declination is set to the correct setting using NOAA's calculator, via their website. Back in the day, it was common practice to set the compass to the magnetic declination. This created two problems. One, the source that was used for this information was from the USGS topographic maps of the area. Since the maps were generally many years old, the correct declination was not being used. Secondly, since survey standards were non-existent at the time, some cavers set their compasses and some did not. This is not a problem in itself, the problem lies in the fact that many did not record on the survey if they set or did not set their compass. Currently, there are 2,351 loops in the Wind Cave survey that are recognized by COMPASS. Of which, 315 are deemed as bad, which is 14% of the total. This represents an 11% reduction in the percentage of bad loops in the Wind Cave survey data over the previous 12 years, all while adding 1,451 new loops to the data set.

We have been asked why it is so important that we have accurate survey data. It has been illustrated to us time and again that having accurate survey data is critical in managing Wind Cave and the infrastructure above Wind Cave. One illustration of this happened in 2002, when a survey team led by Rene Ohms observed a waterfall in a dome near the Natural Entrance during a rainstorm. By using a cave radio, it was determined that the top of the dome was only six-feet below the sidewalk going out to the Walk-In Entrance. It wasn't long after this discovery that Maintenance put out a request to dig a trench alongside that same sidewalk. Knowing the dome was there allowed us to potentially avert damaging the cave or creating a safety hazard for our employees by digging a trench over the top of this shallow dome. This one example demonstrated not only why having as accurate of data as possible is critical but why we continue to survey Wind Cave.

Although, we have realized since we started at the park that having good quality sketch is important to cave maps, it wasn't until we started the latest update to our digital cave map that the full importance of that data was realized. Although, Wind Cave surveyors sketch at 20 feet to the inch, only the walls and most important features were used on all previous Wind Cave maps. Essentially, we were collecting higher resolution data than we could use on the 50 feet to the inch cave quadrangles. On the newest digital map, we are digitizing all of the interior passage detail from the in-cave sketches. Without sketches that are drawn to scale and sketches that have interior detail, there is nothing to add to the new digital map. Unfortunately, both of these situations exist in most of the pre-cave management survey data (the 37.07 miles of pre-cave management sketch).

During the first year of the Wind Cave Resurvey Project, which was in 2000, 0.48 miles of problem surveys were resurveyed. Since that time, the amount resurveyed each year has fluctuated. The most productive year was in 2005 when 3,535 feet were resurveyed, with the least productive year in 2004, when 1,109 feet was resurveyed. However, overall, during the 12 years since the project started, we have averaged about 2,463 feet or 0.46 miles of resurvey a year. This was accomplished by resurveying 89 partial or complete surveys, most of which are in the Historic

Section of the cave. During this same time period, we averaged 4.3 miles of new survey per year throughout the whole cave, in addition to the resurvey totals. To date, 5.59 miles have been resurveyed under the Wind Cave Resurvey Project. This represents about 15% of the 37.07 miles of pre-cave management survey that existed in the Wind Cave survey database. At the current rate, it will take 67.5 more years to resurvey the whole 37.07 miles. We obviously need to find a better way to attack this behemoth. One tactic that we have pursued, unfortunately unsuccessfully thus far, is obtaining a funding source and hiring a team to tackle this problem for a couple of years. Even though we haven't been able to secure funding thus far, we will continue to search for ways to bring all of the Wind Cave survey data up to current cave management standards.

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Wildlife Population Estimates March 2012

By Barb Muenchau, Wildlife Technician

The following wildlife population numbers are estimates, since we do not manage our wildlife species as intensively as some agencies. Most estimates have been made through Park wildlife surveys and include the "Casey Addition" new lands.

Species	Population Numbers
Bison	350-375
Elk	~ 900
Pronghorn	80-90
Mule Deer	*100-125
White-tailed Deer	*100-125
Black-footed Ferrets	46-64
Prairie Dogs	1700-1800 Acres

*Deer numbers are our "Best Guess" estimates as no deer surveys have been formally conducted in the Park. Anecdotal evidence suggests that there appears to be an increase in the white-tailed deer population and a decrease in the mule deer numbers, a switch from 10-15 years ago.

Why are those ATV tracks in Wind Cave NP?

by Beth Burkhart, WICA botanist

Most people's ideal for Wind Cave NP includes untracked cave passageways winding off into the blackness and untrampled mixed-grass prairie and ponderosa pine forest extending to the horizon. Indeed, the key management provision of the NPS Management Act of 1916 says that the purpose of the NPS is to "…conserve the scenery and the natural and historic objects and wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." However, this is easier said than done! The dual purpose of conserving and enjoying sets up a constant balancing act between performing necessary conservation/management actions and leaving no long-term trace.

Relative to Wind Cave, an example of the balance between action and impact is working out a compromise between allowing large numbers of people into the cave on tours (i.e., education and enjoyment of current generations) and maintaining natural cave airflow founded on limited and/or small openings. Natural airflow is critical for the cave to exist unimpaired into the future (for the education and enjoyment of future generations). To better manage airflow, a new airlock entrance has been planned and designed by WICA staff and reviewed by the public – and will be constructed in fall 2012. Even with Best Management Practices, the construction of the new airlock entrance will cause short-term impacts to the cave as well as to Wind Cave Canyon in the vicinity of the entrance. The construction will also cause some long-term impacts to a small part of Wind Cave Canyon, but analysis of those impacts through the park's internal planning process and external/public process (WICA Airlock Environmental Assessment 2012) has resulted in the science-based conclusion that the negative impacts are not significant – while the benefits are!

Aboveground, ponderosa pine forests and mixed grass prairie are dynamically interacting systems of plants, animals, insects, geology, soils, water, etc. While at times (especially on foot), the park's 33,851 acres seems large, the reality is that the park is just a small piece of the ecological systems of the southern Black Hills. It may be tempting to think of Wind Cave NP as a bubble of paradise perking along in perfect harmony, but the reality is that Wind Cave NP is actively managed. Take several wildlife populations without natural predators and enclose them in a limited area of land/forage/water – natural resources will be overrun in a finite number of years without management!

- Several wildlife populations would not limit themselves to WICA property if not for the park fence (e.g. bison), so an effective fence is a key management tool.
- Some wildlife are attracted to WICA property by management choices (e.g. lack of hunting motivates some elk to visit the park). Recent update of the park's boundary fence including elk "gates" allows park staff to manage elk ingress/egress.
- Non-native, invasive plant species on the southern Black Hills landscape move into and around WICA, sometimes developing into infestations that displace habitat for native wildlife (e.g. horehound (*Marrubium vulgare*) covering approximately 1,000 acres was the target of a large treatment project in 2011 and will be again in 2012).
- Non-native pests also include the plague bacterium (*Yersinia pestis*) that can cause sylvatic plague in prairie dogs and black-footed ferrets (federally endangered species). Plague has drastically reduced prairie dog numbers in western South Dakota in recent years; dusting prairie dog burrows for fleas (vector for plague transmission) in 2009-2011 has been an important investment by WICA staff to protect WICA prairie dogs and black-footed ferrets.

These examples have 2 things in common –

1. they protect/conserve WICA natural resources so future generations can enjoy unimpaired WICA ecosystems; and
2. they at times utilize Off-Highway Vehicles (OHVs – includes All-Terrain Vehicles, Utility Terrain Vehicles) to accomplish work.

Figure 5. ATV's at herbicide mixing station in Sanctuary prairie dog town during horehound project August 2011.

Permanent OHV trails and OHV use by the public are not considered compatible with Wind Cave NP purpose (that is, to protect unique Wind Cave resources and preserve and enhance mixed-grass prairie and native wildlife, while providing for the enjoyment of the public (Wind Cave NP Foundation Statement, September 2011).

However, temporary OHV use for administrative uses is critical for achieving some park projects within a reasonable time period and budget. Foot travel may be appropriate and is employed for some projects. For others, though, the time to complete a project or the need to supply heavy materials (e.g. fence materials, water for herbicide) makes foot travel unrealistic for achieving project goals.

Figure 6. Temporary bridge over Beaver Creek used for OHVs to bring new materials into and old materials out of 2011 boundary fence project; bridge removed in September 2011.

Temporary OHV use is carefully planned by interdisciplinary teams of park staff to minimize impacts (e.g. by minimizing the number and length of trails and choosing least-impact locations relative to known cultural and natural resources). Temporary OHV trails are still not a natural sight – and may remain visible for more than one growing season after use, depending on precipitation and other factors. In all cases, the impacts of temporary OHV use to support projects (analyzed in Environmental Screening Forms completed for each project) must be determined to be less detrimental than other reasonable alternatives before temporary OHV use is approved.

No WICA employee is pleased with making or seeing OHV tracks on the mixedgrass prairie "where the deer and the antelope [and bison] play"! But long-term benefits to protect park resources outweigh short-term impacts to an aesthetically pleasing view.

It is important that the public be aware of the ongoing balancing act between short and long term impacts and goals – and why those OHV tracks are out there in the park. Interpretation of the wonders and beauty of WICA mixedgrass prairie and wildlife is important, but so is interpretation of the challenges for managing a complex park area like WICA. The public can only understand and appreciate what they know. If they think the park "runs itself" and the hand of humans should be completely invisible, it is likely they won't be supportive of park management, now or in the challenging days of climate change ahead.

Figure 7. Temporary OHV track from 2011 access to boundary fence project in August 2011 after work completed. Photomonitoring will record track recuperation through 2012 growing season and beyond.

If you have any questions, suggestions, or concerns about temporary OHV trails in Wind Cave NP, please talk to Beth Burkhart, Resource Management, or Mark Greene, Maintenance.

Is Alvin McDonald Disappearing?

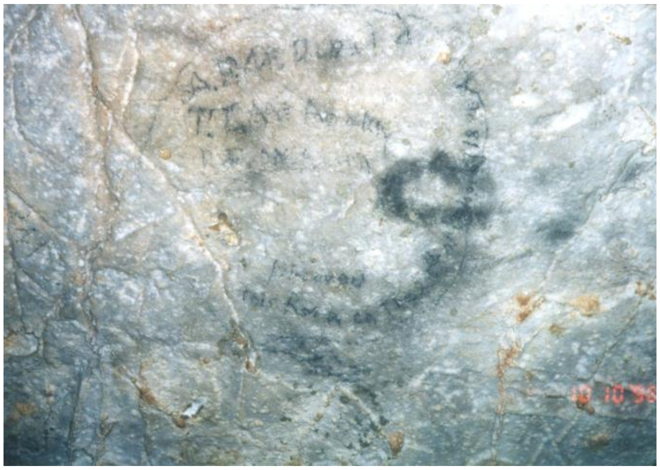
By Rod Horrocks, Phy. Sci. Spec

I recently noticed that the A.F. McDonald discovery signature in the Assembly Room was almost impossible to read, an observation additionally reported to me by the Park's long-term interpreters. We all remembered being able to read that signature fairly recently and I remembered being able to read it when I first arrived at the park in 1999. I found this puzzling and I speculated on reasons why this deterioration was occurring. One of the most likely reasons is that this signature is found in the ceiling only a foot above the heads of our visitors in a room that is used by four different tours (the Natural Entrance, Fairgrounds, Candlelight, and Blue Grotto Tour Routes) and nearly all of our cave visitors pass through that room. However, it should be pointed out that only the Natural Entrance tour regularly stops in that room. Marc Ohms and I speculated that it might be either dust, touching, or elevated temperatures from the visitors that was causing this deterioration, or a combination of those. It also occurred to me that the writing might have been retraced some time after the inscription with graphite instead of lead by some unknown person. But these are only speculations and are not based on any testing or analysis on my part.

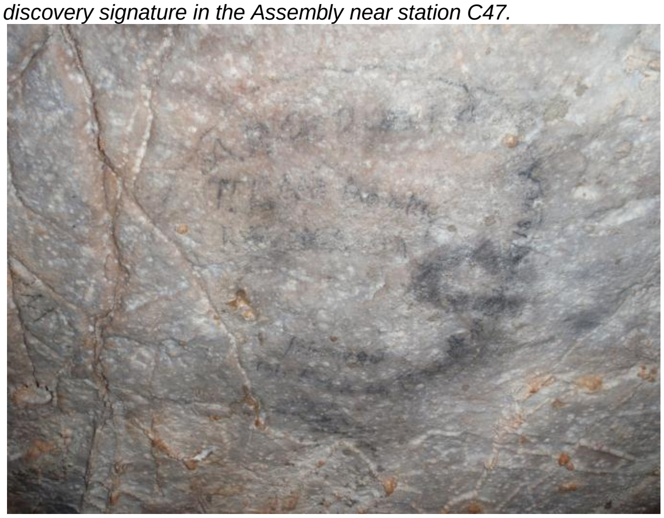
When I recently found a picture in our photo archives of that same signature from 1998, I decided to take another picture in an attempt to document any deterioration since that first photo was taken. In the 1998 photo the signature and accompanying text can be read, just barely, much like I remembered it from 1999. By comparing the 1998 photo with Alvin McDonald's diary entry about discovering Fallen Flats (what we now call the Assembly Room), I think that the original inscription on the ceiling of the Assembly Room said,

"A.F. McDonald
F.L. McAdams
R. F. McAdams
Discovered this room on the 25th of October 1890"

What makes this type of photo comparison difficult is that the 1998 photo was originally shot with film and then scanned from a print, while the 2011 photo was digital. The flashes were also different. This results in varying appearance and resolution for each photo. Despite the problems with these types of photo comparisons, the photos still seems to show apparent deterioration. The question that this observation raises is are the historical inscriptions along the tour routes degrading faster than inscriptions away from the paved trails? We really don't have a good inventory of inscriptions found along the tour routes. However, we do have some spotty off-trail inventory completed at the time that those passages were surveyed. All this means that we still have much work to do regarding these type of cultural resources. Below are the 1998 and the 2011 photos for comparison:



1998 Photo: *October 10, 1998 photo of the A. F. McDonald discovery signature in the Assembly near station C47.*



2011 Photo: *November 21, 2011 photo of the A. F. McDonald discovery signature in the Assembly near station C47 thirteen years after the 1998 photo.*

Horehound in Wind Cave NP – Treatment starts in 2011 and continues in 2012

by Beth Burkhart, WICA botanist

Several previous issues of Resource Ramblings reported on concerns about white horehound (*Marrubium vulgare*) infestations in Wind Cave National Park. A new chapter in the story was written in 2011, with more to come in summer 2012.

In 2011, the Northern Great Plains Exotic Plant Management Team (EPMT) came to Wind Cave NP and worked with WICA vegetation crew to chemically treat approximately 900 acres of horehound infestation in Sanctuary, Research Reserve, and Southeast prairie dog town areas (chemical used: metsulfuron methyl (Escort). The project was implemented August 15 – 19 and involved the use of 12 OHVs. To reduce impacts and increase project efficiency, the number of OHV trips was reduced by pumping water to the project sites through approximately 3 miles of fire hoselay. Herbicides could then be mixed on site to replenish empty OHV tanks. [Special thanks from Wind Cave NP vegetation crew to Wind Cave NP Fire and Maintenance staffs for assistance with hose, pump, and water operations.]

Everything went smoothly, until a bison herd showed up at the Sanctuary work area! Patience and an early lunch break allowed the herd to move through and work to resume.

Northern Great Plains EPMT also developed a task order for a contractor to treat 200 acres of horehound in East Bison Flats with a truck-mounted boom sprayer. The topography of the area made this application method appropriate and efficient – one truck pass covered what would have taken 4 OHV passes to provide the same application.

Figure 8. Kevin Kovacs buys time with bison so mixing station materials could be relocated until a bison herd moved through Sanctuary treatment area.

Small trials treating horehound in 2010 with Escort in Wind Cave NP were successful, but it is still too early to evaluate the results of the larger 2011 treatments. Escort is a growth inhibitor that inhibits cell division in shoots and roots so its impacts are not readily observable until the growing season following treatment.

We will be monitoring 2011 results as we prepare for 2012 treatments. The Northern Great Plains EPMT will be returning to Wind Cave NP this summer (August 13-17) to continuing working with park vegetation crew on the Wind Cave NPs horehound treatment plan. We also received additional funding this year from NPS project fund sources to hire additional seasonal crew members so we can refine the 2011 treatments.

Figure 9. Truck-mounted boom sprayer on East Bison Flats in September 2011.

The hope is that a couple of years of these large-scale treatments will be effective in pushing horehound to a background condition that the park's standard vegetation crew can continue working on within the scope of a regular summer's workload. Unfortunately, we have had almost a decade of horehound setting seed in Wind Cave NP as we've been coming to grips with the situation. Consequently, we will be dealing with new horehound seedlings for many years to come, even when we are on an improving trend.

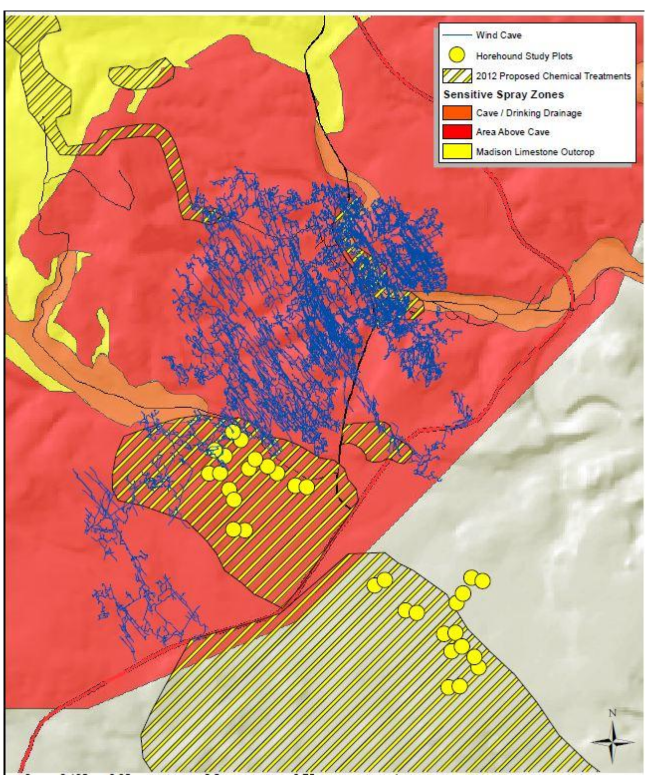


Figure 10. Herbicide monitoring implementation plan: striped polygons in the red area are 2012 herbicide treatment locations that will be monitoring by subsurface water sampling/testing.

Another excellent step in responsible herbicide management at Wind Cave NP in 2012 is development of an herbicide monitoring plan by Wind Cave NP Physical Science staff (Marc Ohms). No treatments of horehound above Wind Cave or karst with park-approved chemicals (metsulfuron methyl and glyphosate) have occurred yet because of concerns for the cave. The new monitoring plan that will be implemented this year involves pre-application testing of water samples from 3 locations in the cave before herbicide application, application of herbicides with a tracer dye, and post-application testing of water samples from the same 3 locations for herbicides and dye over a six-month period.

Our hypothesis, after research and consideration, is that none of the park-approved herbicides will be detected in any of the post-application samples given the herbicide characteristics and depth to cave. If dye is detected but herbicides are not, that will be the clearest evidence that herbicides are interacting as predicted with vegetation and soil – and having no impact on Wind Cave. If no herbicide and no dye are detected, some question will remain as to whether there is a path from the surface to the sample point – but the goal of no herbicides in Wind Cave will still be met. Based on the characteristics of the park-approved herbicides and depth to cave, we don't expect any herbicides to be detected. However, if they are, we will fall back once again to no application of these herbicides over Wind Cave – and continue our search for tools to stop horehound disruption of surface ecology that do not disturb subsurface systems.

For more information on 2012 horehound treatment in Wind Cave NP or the 2012 herbicide monitoring plan, contact Beth Burkhart WICA Botanist.

Highland Creek Dye Trace

Marc J. Ohms, Physical Science Technician

Background

Highland Creek starts as a series of small springs in Custer State Park, about ¼ mile from Wind Cave National Park's northern boundary. The relatively small watershed of Highland Creek receives some local runoff but the stream is largely spring fed. The springs are very dependent upon precipitation, and with lower precipitation come lower stream flows. As the stream enters the park it encounters the Madison Limestone and begins to lose some of its flow. Depending upon flow conditions, the stream may end here, or if the flow is substantial, it continues downstream until it finally looses the remainder of the flow to loss zones within the Minnelusa Formation. (*Ohms 2009*) The stream is rarely more than two miles in total length, and has an average discharge of just over 1.0 cubic feet per second. During a 2002/03 study by the US Geological Survey, it was found that the highest concentration within the park for dissolved nitrite plus nitrate was from Highland Creek. However, no wastewater compounds were found at levels above the minimum reporting level, and overall Highland Creek is the least impacted stream within the park (*Heakin 2004*). The stream is home to the non-native brook trout and a healthy population of invertebrates, including two species of caddis fly previously unrecorded in the state of South Dakota (*Heakin 2004*).

During the spring of 2008 an employee reported to the author that a hole had recently formed and was taking the entire flow of Highland Creek. An investigation discovered a recent collapse had occurred directly in the streambed and that it was indeed taking the entire flow of Highland Creek (see Figure 11). This phenomenon ended about as quickly as it came, and by the end of the summer the stream filled the opening back in with gravel and cobbles, and the flow was returned downstream. This is a good example of how dynamic hydrology within karst can be.

Figure 11.

Roughly five miles to the southwest of Highland Creek is Wind Cave (see Figure 12), consisting of over 137 miles of known passages. At its lowest point, the cave intersects the water table of the Madison aquifer, resulting in a group of subterranean open water bodies, collectively known as "The Lakes."

Lying five miles directly to the south of Highland Creek are the park's wells (see Figure 12). Park Well #1 was drilled in 1956 to a depth of 790 feet. The well starts in the Minnelusa Formation and reaches into the Madison Limestone where it intersects the Madison Aquifer, and continues down through the Englewood and Deadwood Formations to the igneous rock. As of 2012, this well continues to serve as the park's sole water supply. In a 1986 dye trace, dye that was injected into Beaver Creek was detected in the well after one month and persisted for several months (*Alexander and Davis 1989*). Dye was not detected in the cave lakes. Park Well #2 was drilled in 2002 to a depth of 685 feet, placing it in the Madison Limestone and aquifer.

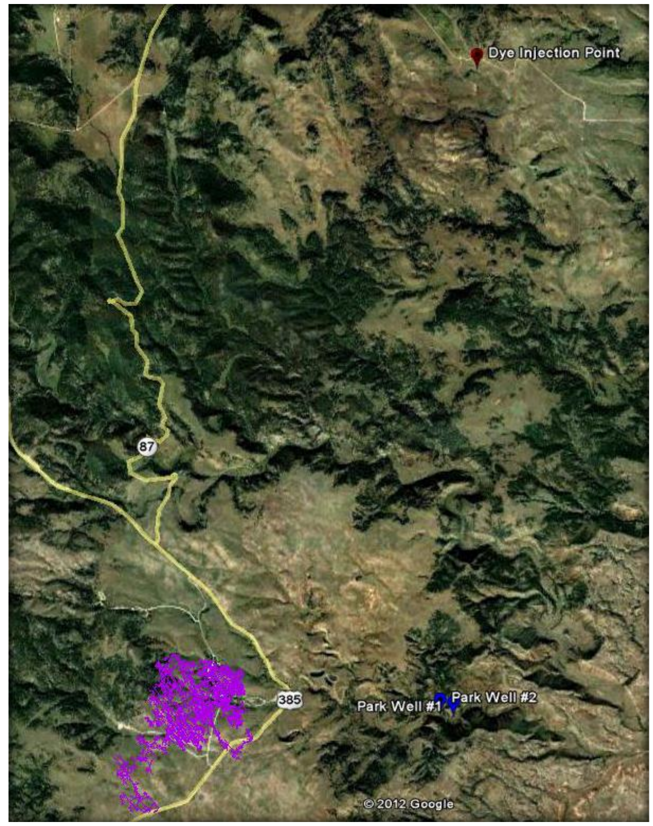


Figure 12

The elevations of the sites are- (these are approximate figures as the water levels fluctuate)
Sink point of Highland Creek- 4286 feet
Calcite Lake in Wind Cave- 3648 feet
Park Well #1- 3816 feet (top of well casing) water elevation is 3642 feet
Park Well #2- 3825 feet (top of well casing) water elevation is 3649 feet

Purpose

The purpose of this qualitative dye trace was to improve upon our understanding of the potential hydrologic connectivity of Highland Creek and various groundwater locations within the Madison Aquifer.

Procedures

On June 4th, 2008, 2.5 liters of Rhodamine WT was injected into the sink point of the stream (see Figure 13). Dye receptors (small packs of charcoal in screen mesh) were placed in Calcite Lake within the cave to detect if the dye passed through the site. Grab samples were taken at the wells.

Figure 13

Results

The dye receptors were analyzed for the presence of Rhodamine WT using a Shimadzu Model RF-5301PC Synchronously Scanning Spectrofluorophotometer by the Crawford Hydrology Laboratory at Western Kentucky University. As can be seen in Figure 4, no dye was detected in any sample taken over the course of the study period.

LOCATION	DATE	Rhodamine WT in ppb
Calcite Lake	7/9/2008	non-detect
Calcite Lake	11/9/2008	non-detect
Calcite Lake	1/7/2009	non-detect
Calcite Lake	4/25/2011	non-detect
Calcite Lake	8/18/2011	non-detect
Park Well #1	8/4/2008	non-detect
Park Well #2	8/4/2008	non-detect
Park Well #2	9/11/2008	non-detect
Park Well #2	6/30/2009	non-detect

Conclusions

Negative results in a dye trace should not be taken as if nothing was learned. For starters, negative results simply indicate that dye was not detected at the sample sites within the time frame studied, and within detection limits of the dye. The limited number of sites that were sampled is due to the fact that there are not many access points (springs, wells, etc) to the Madison Aquifer within the area. Knowledge of where the water of Highland Creek travels once below ground was not gained during this study. However, understanding that the water does not appear to travel to the cave lakes nor to the park wells, is knowledge gained.

References

Alexander, Calvin Jr., Marsha Davis, and S. Alexander. 1989. HYDROLOGIC STUDY OF JEWEL CAVE AND WIND CAVE: FINAL REPORT. University of Minnesota, 196p.

Heakin, Allen. 2004. STREAMFLOW AND WATER QUALITY CHARACTERISTICS FOR WIND CAVE NATIONAL PARK, SOUTH DAKOTA, 2002-03. Scientific Investigations Report 2004-5071, 68p.

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Sharp-tailed Grouse "On the Rise Again"

By Dan Roddy, Biologist

Current resource management staff has been monitoring trends of Sharp-tailed Grouse numbers in the park since 1999. The number of grouse observed on the leks (display/dancing locations) in the spring has steadily decreased since 1999 when there were 91 grouse on the leks down to only 11 grouse in the spring of 2011.

The big turn-around in grouse numbers appears to have begun in 2010-2011. During the Wind Cave Christmas Bird Count (December 2010) the bird counters found 52 grouse in the park compared to only 5 the year before. The numbers seemed to be on the rise in the winter months but even as recent as last spring the number of grouse using the leks in the park was still down.

Finally, April 2012 we began to experience the apparent recovery of the grouse in the park. The recent count detected as many as 43 birds on April 18th which is the highest number of grouse since 2007 when at that time there were 57 counted. On the southern end of the park where birds had not been observed on the leks since 2007, staff counted 23 birds this year on one lek.

Interesting to note that our observations are in line with what others are finding in western South Dakota. Over the past 2 years South Dakota Game Fish and Parks has also been finding a similar increase in Sharp-tailed Grouse numbers over western South Dakota. Their grouse surveys have demonstrated an upswing from the last few years as well as landowners commenting on the abundance of grouse in 2011 and 2012. Also, according to Wildlife Biologist with the National Grasslands, similar findings have also been recorded for Sharp-tailed Grouse over the past 2 years.

Date	**Maximum Birds Counted**	Southern end of Park	Eastern half of Park	Comments
1999	**91**	37	54	Active leks (3 southern / 4 or 5 eastern)
2004	**56**	19	37	Active leks (2 southern / 4 eastern)
2007	**57**	08	49	Active leks (1 southern / 4 eastern)
2008	**16-18**	00	16-18	Active leks (0 southern / 2 eastern)
2009	**17**	00	17	Active leks (0 southern / 3 eastern)
2010	**14**	00	14	Active leks (0 southern / 3 eastern)
2011	**11**	00	11	Active leks (0 southern / 1 eastern)
2012	**43**	23	20	Active leks (1 southern / 2 eastern)

Table 1. Demonstrating the downward trend for grouse in the park from 2004-2011

Adding to our monitoring effort in 2012 we also included the new lands (Sanson/Casey Ranch). Our best estimate for that part of the park is an additional 28-34 grouse. Observations of these birds were interesting from the standpoint that none of the birds appeared to be displaying on what we would consider typical lek sites. In fact, we were not able to determine any lek sites where the birds were displaying from although we continued to see birds in the vicinity of the Sanson Ranch, old corrals on the southern end of the property and just off Highway 385 north of the Southern Black Hills Water System's trailer. I guess there is always next year to try and figure out where the leks are located but for now it is good to see that the Sharp-tailed Grouse are "On the Rise Again.

IN CASE YOU ARE INTERESTED: April 2012, while observing a lek on the northern end of the park, Barb Muenchau video-taped some of the sights and sounds made by Sharp-tailed grouse. I think you will find their behavior interesting as well as amusing, especially when the males all appear to be wound up and let go at the same time. It is akin to a bunch of wind- up toys being wound up as tight as they can, then they're all let go at the same time, only to move quickly one way then change directions to go in another direction until they run out of power. Lots of time the male grouse start and stop at the same time as though they run out of steam at the same time. To watch the video of the grouse behavior, go to

S:\Resource Management\Wildlife Management\Wildlife Reports\video clips

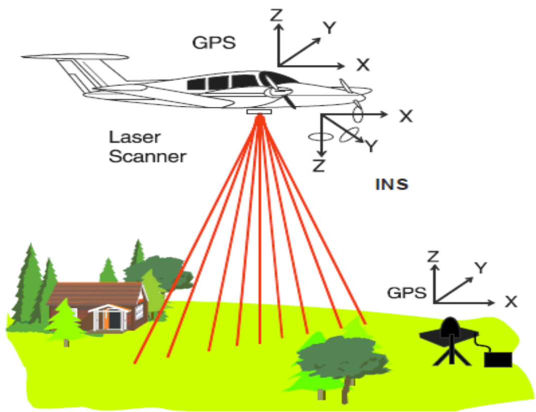
Enjoy! (BE SURE AND TURN YOUR VOLUME UP ON YOUR COMPUTER TO HEAR THE SOUNDS TO GO ALONG WITH THE VIDEO)

Technology in natural resource management: LiDAR

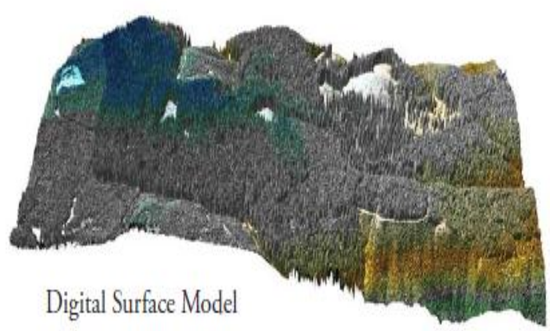
By Kevin Kovacs, Biological Science Technician

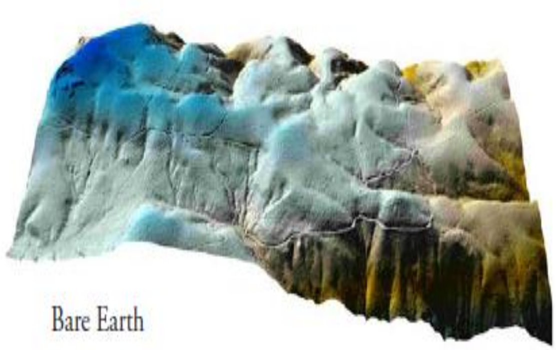
What is LiDAR? LiDAR stands for **Li**ght **D**etection **A**nd **R**anging. It is an optical remote sensing technology that can measure the distance to a target by illuminating the target with light. More simply put: it's using light to measure the world around us. LiDAR has a variety of applications ranging from meteorology to navigation of unmanned vehicles, but the most common uses are in mapping and natural resource management.

The principal behind LiDAR is quite simple. Shine a light at a surface and then measure the time it takes to reach that surface and return. In LiDAR, the light comes from a laser which is often mounted to an aircraft. The laser light is transmitted, in short pulses, to an oscillating scanner. The scanner distributes the pulses of light across the surface being measured and then photodetectors register when the light returns. The laser light is reflected from every surface that it touches. This includes rocks and dirt as well as grass, trees and buildings. Computers are used to track the amount of time each light pulse takes to return to its source and then calculate a distance from the laser to the surface. The computers also track the location of the laser (using GPS) and its position (the angle the light traveled or pitch, yaw and roll). This information is all combined to give an exact location.

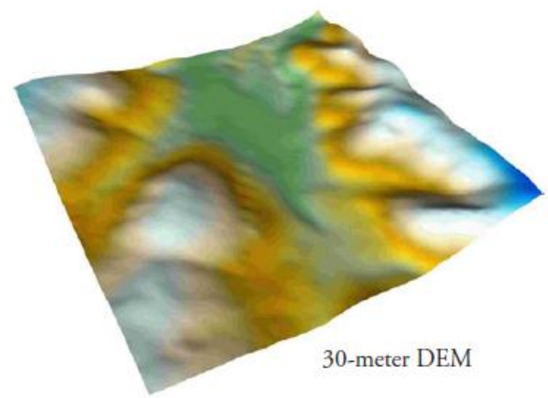


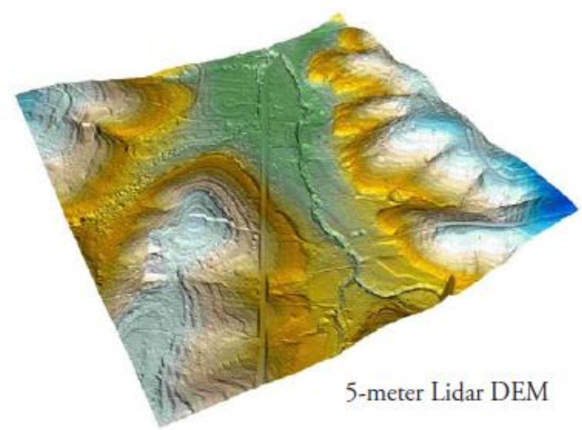
LiDAR Lasers can send upwards of 100,000 light pulses per second creating a “point cloud” that can be analyzed. On large land bases this can create very large point clouds containing millions and millions of points. This sheer volume of data makes LiDAR a versatile tool allowing it to be used in many types of analysis. The LiDAR point cloud can be used to create several different products that can be useful in areas natural resource management. Two of those are the Bare Earth Model which shows only the ground surface and Digital Surface Model which shows all surfaces, including vegetation.


Digital Surface Model

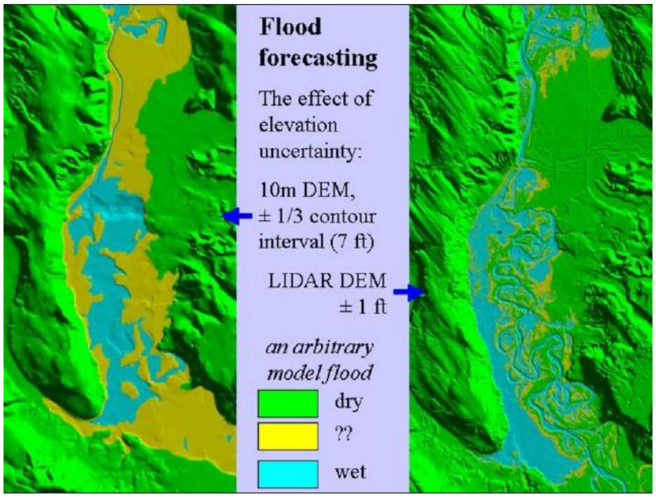

Bare Earth

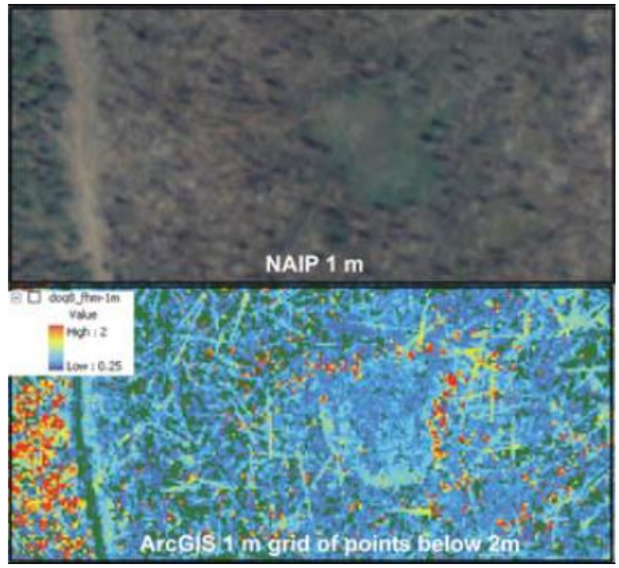
The “Bare Earth Model” is the most common product. It uses a subset of the point cloud data points which are at the ground level. You can think of this product like a digital picture, only the pixels represent elevation instead of color. It creates a 3-D representation of the land with any vegetation removed. These bare earth models are identical to the Digital Elevation Models (DEM) found in the National Elevation Dataset (NED), but are significantly higher resolution. Just think of how more detail is displayed in higher resolution pictures. The standard DEMs offered at the NED range in resolution from 30 meters to 10 meters. A LiDAR derived bare earth model can have a resolution of less than 1 meter. This increased resolution allows harder to detect or smaller features to be seen more easily. This kind of data can better detect the curvature of rivers and streams, helping to determine movement of water across the landscape. Currently FEMA and USGS use LiDAR for mapping flood zones and other hydrologic features. It can also help to prioritize cultural artifact and archeological survey


30-meter DEM


5-meter Lidar DEM

efforts as human impacted sites become more visible. At historic sites in Canada, the technology has been used to map archaeological features beneath the forest canopy that would have otherwise gone undetected. LiDAR has also been used to detect archaeological sites covered by flattened vegetation (such as prairie grasses) by measuring the intensity of the light returned to the sensor. The higher resolution of LiDAR data will also yield more consistent and accurate elevation data. This data can aid planning efforts for construction and maintenance projects by reducing the amount of survey work necessary.





Using the digital surface model in mapping forest/canopy structure the whole point cloud is used in an attempt to infer more information about environment aside from elevation. The laser pulses from the LiDAR laser are reflected by anything that they come in contact with. This includes trees, rocks, shrubs, buildings and any other solid surface. The light that reflects off of tress and other plants creates a large set of points above the ground. From this data forest structure, tree density and canopy density can be mapped. This kind of data can be used to map the habitat of forest structure dependent animal species like flying squirrels, many bird species, and the pine marten. LiDAR can also be used to determine fuel loading as the point cloud makes downed trees visible. This data can be used to assess the potential risk of fire effects across the landscape.